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And in like manner $p=1\div q$, $l=\sqrt{[S(d_1^2)\div nq]}$, means that if $1\div q$ of the n, or $n\div q$ errors, are equal, each will be this value of l, and that these are as likely to be less than, as to exceed $l=\sqrt{[S(d_1^2)\div 2nq]}$ .... (7), which is therefore the probable error $1\div q$ of the n errors. Hence $l=\sqrt{[S(d_1^2)\div 2n^2]}$ .... (8) is the limit which includes $\frac{1}{2}$ of $1\div n$ of the n errors, that is, the limit which includes $\frac{1}{2}$ of one error and therefore the least one of the n, which may be taken as the probable error of the point, line or surface determined by $S(d_1^2)$ = a minimum = a constant also for different sets of n similar observations, since an error in the starting point and in the same direction in which a line is measured entails the same error upon the estimation. Wherefore, from (7) and (8), when the probable error for one observation is $\sqrt{[S(d_1^2)\div 2n]}$, that for m is $l=\sqrt{[S(d_1^2)\div 2mn]}$.

Ultimate Proposition in Attraction.—If the points of every particle of matter attract the points of every other particle of matter, then the resultant attraction between any two particles, whose dimensions are infinitely small in comparison with the distance between them, will be directly as the product of their masses and inversely as the square of the distance between them.

That it is as the product of the masses, when the distance is constant, results from the consideration that if the density of one be increased or diminished in any ratio, the number of attracting points and forces is increased or diminished in the same ratio without affecting their directions; the force of attractton varying then as the mass of one when the other is constant must vary as the product of the masses when neither is constant.

That it is in the inverse ratio of the square of the distance, follows first, from the fact that any two points of matter of the same density, attract each other with a constant force for all distances, because the point of application of a force may be any where on its line of direction, distance being a quantity of a different kind has no effect on force; second each point of each particle being a centre of attraction for all other particles, the number of these equal forces applied between two particles is directly as the product of their masses and inversely as the square of the distance between them, as a necessary consequence of their situation.

R. J. Adcock.

[By request of Mr. Adcock, the above note is re-stated, as amended by him and returned to us with the "proof" to which we referred at page 190, Vol. IV.

In proof of Mr. Adcock's proposition, and as a *correction* of our assumption at p. 190, Vol. IV, that the attraction is as the sum of the masses, we insert the following extract from a paper on the subject furnished by Alexander Evans, Esq., of Elkton, Maryland.—Ed.]

In *Poisson's* Mechanics, Vol. I, Ch. VII, Section 242, will be found the following: "Seeing the smallness of the sun and planets with respect to the distances which separate them, we conceive that these attractions may be regarded with sufficient approximation as those of forces parallel and equal in the whole extent of the same planet, their resultant is therefore equal to their sum and the distance remaining the same "la force *motrice*" of each planet is proportional to the product of its mass and that of the sun." * * *

"Let f be the attractive force of one of the two bodies upon the other, that is to say, the numerical ratio of its intensity to that of the force chosen for unity: let also M and m be the masses of the sun and that of the planet, "la force *motrice*" of the planet will be fMm at the unit of distance, and will become $\frac{fMm}{r^2}$ at any distance r, * * *." La force *motrice*" of the mass M due to the attraction of m is also represented by $\frac{fMm}{r^2}$ in such a manner that the reaction of each planet upon the sun is equal and contrary to the action of the star upon the planet, but "la force *motrice*" $\frac{fMm}{r^2}$ acting upon the two masses M and m will impress upon them at every instant velocities infinitely small which are respectively proportional to these masses, or otherwise expressed, their "forces *accellatrices*" are $\frac{fm}{r^2}$ and $\frac{fM}{r^2}$."

That is, the forces of nature being measured by the velocity acquired in the unit of time, it is necessary to divide each "force *motrice*" $\frac{fMm}{r^2}$, by the respective masses, M and m, in order to obtain the velocity of each body, which varies inversely as its mass; these *accelerative velocities* therefore become $\frac{fm}{r^2}$ and $\frac{fM}{r^2}$; these are taken as the measure of the celestial (as of all) forces, and amount together to $\frac{f(M+m)}{r^2}$, so that the masses of the two bodies may be supposed united in one body for the expression of the *accelerative* or velocity force (so to speak).—And Poisson says further:

"It is necessary to conceive that we impress at every instant upon the sun an infinitely small velocity equal and contrary to that which it receives from the attraction of the planet; but in order not to alter the relative movements of the two bodies it will be necessary at the same time to impress this velocity upon the planet, and this amounts to applying to it a "force *acceleratrice*" equal and contrary to that of the sun: then in the movement of which there is question the "force *acceleratrice*" of the planet m will be constantly directed towards the sun M and equal to the sum of the two forces $\frac{fM}{r^2}$ and $\frac{fm}{r^2}$; if then we wish to express it by $\frac{\mu}{r^2}$ as in number 225 it is necessary to take $\mu = f(M+m)$."

SOLUTION OF A PROBLFM.

BY MARCUS BAKER, U. S. COAST SURVEY.

IF the centers of the escribed circles to any plane triangle be joined two and two a new triangle is formed, which call the *first derived triangle*; if in like manner the centers of the escribed circles to the first derived triangle be joined two and two another triangle is formed, which call the *second derived triangle.* Let this process be continued till we reach the n^{th} *derived triangle.* It is repuired to determine an expression for the area of this n^{th} derived triangle in terms of functions of the original triangle.

Let $\triangle_0$ represent the original triangle, K_0 its area, s its semiperimeter and R the radius of its circumscribing circle; also let $\triangle_n$, K_n, s_n and R_n represent corresponding functions of the n^{th} derived triangle.

Let A, B, C represent the angles and a, b, c the sides of the original triangle, and O', O'', O''' the centers of the first set of escribed circles; then is $O''A \sin\frac{1}{2}A = s-c$ and $O'''A \sin\frac{1}{2}A = s-b$ whence $O''O''' = a \div \sin\frac{1}{2}A$;

$$\therefore\quad \left.\begin{aligned} O''O''' = \frac{a}{\sin\frac{1}{2}A} = 4R\cos\tfrac{1}{2}A;\quad O'''O' &= \frac{b}{\sin\frac{1}{2}B} = 4R\cos\tfrac{1}{2}B; \\ O'\,O'' &= \frac{c}{\sin\frac{1}{2}C} = 4R \operatorname{sos}\tfrac{1}{2}C \end{aligned}\right\}. \quad (1)$$

$$K_1 = \frac{O'O''.O''O'''.O'''O'}{4R_1} = \frac{64R^3\cos\frac{1}{2}A\cos\frac{1}{2}B\cos\frac{1}{2}C}{8R}$$
$$= 8R^2\cos\tfrac{1}{2}A\cos\tfrac{1}{2}B\cos\tfrac{1}{2}C.$$

But $4R\cos\frac{1}{2}A\cos\frac{1}{2}B\cos\frac{1}{2}C = s$ and therefore

$$K_1 = 2Rs. \quad (2)$$

It is an immediate inference from (2) that $K_2 = 2R_1s_1$, or generally that

$$K_n = 2R_{n-1}\,s_{n-1}\,. \quad (3)$$

From an examination of the figure we see that the angles of the first derived triangle are the arithmetic means of the angles of the original triangle taken two and two. The second derived taiangle stands in the same relation to the first derived triangle that the first derived triangle stands to the original triangle, i. e., its angles are the arithmetic means of the angles of the next preceding triangle taken two and two.